U. S. DEPARTMENT OF AGRICULTURE
Weather Bureau
Instrument Division.

TRICKLE-CHARGED STORAGE BATTERIES;
INSTRUCTIONS FOR INSTALLATION AND OPERATION.
(For confidential use of employees only)

Voltage and current.- The potential of lead-acid storage batteries is 2 volts per cell, while the potential of the primary cells well known in the Weather Bureau is 0.6 volts per cell. Hence where the maximum number of primary cells needed on any one circuit has already been determined by practice, it is necessary merely to provide one storage cell in lieu of each four primary cells. In the absence of such experience the best operating voltage is computed as one third the total resistance in ohms of the longest circuit. The resistance of the magnets is 5 ohms, and of the circuits 1 ohm for each 250 feet of #16 gage wire. It is customary to add a few ohms as a concession to poor connections, and while one cell of storage battery is adequate for many installations, yet the custom of employing 2 cells has become fairly well established in the Bureau with quite generally satisfactory results. In a few cases where certain instruments are much farther removed from the register than others, or for some reason require more than four volts of battery, either fixed resistances or rheostats, obtainable on stores requisition, are required in the low-resistance circuits to reduce the current intensity.

Storage battery capacity.- A wide variety of capacities is available among the batteries on the market, but the use of cells having more than 100 ampere-hours capacity is not warranted, since the instruments all together require only about 3 ampere-hours per day. This is especially true when the battery is "floated", for energy is being constantly put into the battery to balance the output. For such service batteries of low capacity are recommended. A 40 or 50 ampere-hour size is quite ample.

Choice of storage battery.- The radio-type battery is preferable to the automobile type, since it has relatively few thick plates in contrast to the large number of thin plates used in an automobile battery, which is required frequently to furnish a very heavy current for a short time. The radio battery discharge, however, rarely is more than 2 amperes, and the life of such a battery will therefore be relatively long when used to supply the much lighter current required to operate the meteorological instruments. The automobile battery should be used only in an emergency.

Suitable batteries are not always stocked by local dealers. The radio type battery, however, is readily obtainable from distributing warehouses maintained throughout the country by the foremost manufacturers, the locations and addresses of which the local electrical dealers may easily ascertain from catalogs of the manufacturers.

The battery chosen should be one that can be satisfactorily and continuously serviced, and preference should therefore be given in general to the products of well-established concerns maintaining local service.

Trickle-charged storage batteries.- This economical form of battery power is in use at a large number of stations with satisfactory results. A trickle-charged battery when "floated" requires only about 10 watts of alternating electric-light current.

Definitions.- A storage battery is trickle charged when a charging current of low ampereage, e.g. 0.4 ampere, is employed. The battery is said to be floated when it is being charged and discharged at the same time. When a trickle-charged storage battery is employed and the battery is connected for continuous charge and discharge, the rate of the trickle charge for economy of operation should preferably be adjusted to a value just sufficient to balance the discharge, thus keeping the battery always fully charged when operated normally.

Choice of alternating-current battery chargers.- In the experience of the Bureau with alternating-current battery chargers, satisfactory results have been obtained from the (1) Rectox (#496656) manufactured by the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa., which is a copper-oxide charger having two charging rates, one of .75 to 1.0 amperes, the other one half the high rate; and (2) the Fansteel (formerly called Balkite)RA1, with an efficient electrolytic rectifier manufactured by the Fansteel Products Co., Inc., North Chicago, Ill., maximum rate .75 amperes; and (3) the bulb type of charger, such as the Tungar made by General Electric Co., or the Rectigon, made by the Westinghouse Electric and Mfg. Co.

The copper-oxide or dry-plate rectifier used in the Rectox charger has the advantage over other kinds in very seldom requiring replacement, while the electrolytic and bulb (thermionic) rectifiers occasionally require new electrodes or bulbs respectively.

The RA1 Fansteel has three rates for various purposes. In addition it is equipped with a built-on rheostat to control the charging rate. Twenty-five ohm rheostats for the Rectox charger are furnished on stores requisition. The catalog designation and name of the manufacturers of batteries and chargers should be given on Purchase Requisitions, and, since the cost of a charger and battery does not exceed $50, the name of but one dealer is sufficient. Should a local purchase be difficult, the assistance of the Central Office may be requested.

INSTALLATION AND OPERATION OF TRICKLE-CHARGED BATTERIES.

General instructions for the installation and operation of battery and charger are furnished by the manufacturers or distributors, to be supplemented by the following:

As shown in the circuit diagram, the charger is connected to an alternating-current lighting current of a voltage and number of cycles suitable to the charger, usually 110 volts, 60 cycles. Such a connection should of course be

as short as practicable. The positive and negative posts of the charger are joined to the corresponding battery terminals with the rheostat in series to adjust the rate. If the charger provides more than one rate, use the lowest until need arises for using a higher. Usually the instrument stand affords the most convenient location for both battery and charger. However, some acid fumes are unavoidable and the practice of placing the batteries on a shelf in a closet of wash room is increasing.

When primary batteries are replaced by a trickle-charged storage battery the connection from the CC-B post to the R post on the underside of the register must be removed, and a cross-connection made from the CC-B post to the right-hand velocity post. All other changes are exterior to the register.

When the new equipment is ready for operation, first discharge the battery to the instruments for an hour or so with the charger cut off. Then measure the voltage and the specific gravity if possible, and record same. These maximum values, indicating a fully charged battery, should thereafter be maintained as nearly as possible. Next place the battery on charge while continuing the discharge, cutting in about half of the rheostat resistance. (A more accurate setting to about .35 amperes can be made if an ammeter is also available.) Operate without change for several days. Then take readings again of voltage and specific gravity with charger cut off and compare with those first made. If they are lower, increase the rate of charge by cutting out some of the rheostat resistance; if the battery is still fully charged and gassing freely, decrease the rate. Continue the process until charge and discharge are kept in balance. Readings once a week will suffice thereafter, and the only other attention should be to add a little distilled water to replace evaporation losses; likewise to the rectifying cell if the electrolytic type is employed, following carefully the manufacturer's instructions. Copper-oxide rectifiers are very nearly indestructible, requiring little or no attention after installation, although there is a gradual decrease in the charging current delivered according to Bureau of Standards tests. They generate some heat, which calls for sufficient ventilation. Tantalum electrodes slowly disintegrate and will after several years require renewal.

Another method of maintaining the battery at full charge is to carefully keep the voltage of the "floated" battery between 2.10 and 2.20 volts per cell measured when charge and discharge are occurring. More or less voltage indicates a corresponding overcharge or undercharge, requiring an adjustment of the rate as before mentioned.

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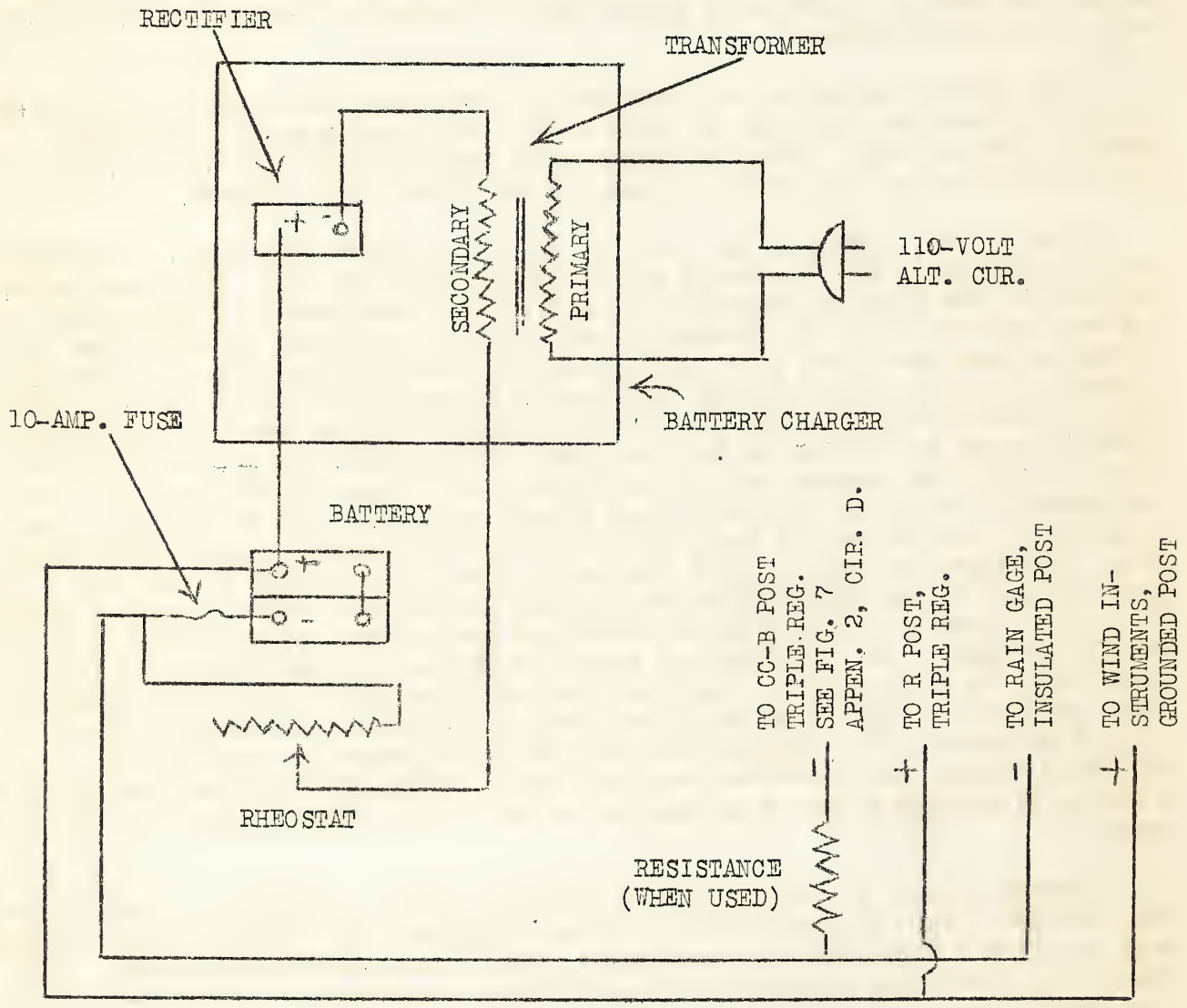
DIAGRAM OF CIRCUITS SHOWING CONNECTIONS
OF TRICKLE-CHARGED BATTERY TO INSTRUMENTS.



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